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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/589,680

08/16/2006

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EXAMINER

LANGMAN, JONATHAN C

ART UNIT

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1794

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/589,680	<b>Applicant(s)</b> NAKABAYASHI ET AL.	
	<b>Examiner</b> JONATHAN C. LANGMAN	<b>Art Unit</b> 1794	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 17 March 2008.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-28 is/are pending in the application.
- 4a) Of the above claim(s) 21-28 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 August 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/16/2006</u> .   | 6) <input type="checkbox"/> Other: _____                          |

**DETAILED ACTION**

***Election/Restrictions***

Restriction is required under 35 U.S.C. 121 and 372.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

In accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.

Group I, claim(s) 1-20, drawn to an article.

Group II, claim(s) 21-28, drawn to a method.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

(1) The special technical feature for each group is not commonly shared.

In particular, the special technical feature of Group I is a SiC crystal. The special technical feature of Group II is a sublimation recrystallization method utilizing a graphite crucible with nitrogen concentrations of less than 50ppm. Therefore, the inventions or groups of inventions lack unity.

(2) The common feature of a doped SiC crystal as instantly claimed in claim 1, cannot qualify as a special technical feature as it does not provide a contribution over the prior art because it is disclosed by Carter Jr et al. (US 2001/0023945) (see rejection set forth below). Therefore, the reference(s) specifically suggests using the common elements as claimed.

During a telephone conversation with John Kelly on April 4, 2009 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-20. Affirmation of this election must be made by applicant in replying to this Office action. Claims 21-28 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

The examiner has required restriction between product and process claims. Where applicant elects claims directed to the product, and the product claims are subsequently found allowable, withdrawn process claims that depend from or otherwise require all the limitations of the allowable product claim will be considered for rejoinder. All claims directed to a nonelected process invention must require all the limitations of an allowable product claim for that process invention to be rejoined.

In the event of rejoinder, the requirement for restriction between the product claims and the rejoined process claims will be withdrawn, and the rejoined process claims will be fully examined for patentability in accordance with 37 CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product

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are found allowable, an otherwise proper restriction requirement between product claims and process claims may be maintained. Withdrawn process claims that are not commensurate in scope with an allowable product claim will not be rejoined. See MPEP § 821.04(b). Additionally, in order to retain the right to rejoinder in accordance with the above policy, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product claims. **Failure to do so may result in a loss of the right to rejoinder.** Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-7 and 11-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Carter Jr. et al. (US 2001/0023945).

Regarding claims 1-7, Carter Jr. et al. teach a Silicon carbide single crystal containing an impurity (nitrogen) in an atomic number density of less than  $1 \times 10^{17}$  and preferably in an amount of less than  $5 \times 10^{16}$ . Carter Jr et al. go on to teach that vanadium is also present in an amount of less than  $1 \times 10^{16}$ , which is less than the amount of nitrogen ([0042]). Carter teaches that by using Nitrogen in such a small

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amount, there is no need to compensate the nitrogen dopants (uncompensated nitrogen) ([0046]). Uncompensated nitrogen is n-type.

Carter also teach that in order to achieve lower amounts of Nitrogen in the Silicon carbide crystal, nitrogen is minimized by using high purity graphite materials in the sublimation growth of Sic ([0040]-[0042]). Since Carter teaches similar methods to those instantly taught as well as similar materials, it is expected that the resulting crystals will have the same material characteristics and properties. It has been held that where the claimed and prior art products are identical or substantially identical in structure or are produced by identical or a substantially identical processes, a prima facie case of either anticipation or obviousness will be considered to have been established over functional limitations that stem from the claimed structure. *In re Best*, 195 USPQ 430, 433 (CCPA 1977), *In re Spada*, 15 USPQ2d 1655, 1658 ( Fed. Cir. 1990). The **prima facie** case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed products. *In re Best*, 195 USPQ 430, 433 (CCPA 1977).

Regarding claims 11, 12, 15, and 16, Carter Jr teach that the Sic may be 3C, 4H, or 6H crystal ([0035]). The act of polishing is a process limitations given little to no patentable weight. The applicant has not claimed any particular surface roughness, therefore any wafer will read on the claim as presented.

Regarding claims 13 and 14, Carter teaches that the resistivity is greater than  $5 \times 10^4$  ohm-cm at room temperature ([0036]), thereby overlapping the instantly claimed resistivity ranges.

Claims 1, 4-7, 11, and 12, are rejected under 35 U.S.C. 102(b) as being anticipated by Jenny et al. ("Deep Level Transient spectroscopic and Hall Effect Investigation of the position of The Vanadium Acceptor Level in 4H and 6H-SiC".

Jenny et al. teach doping Sic with Vanadium and Nitrogen (pg 1963, c. 1, pp. 3). The amount of uncompensated Nitrogen is  $1.5 \times 10^{18}$  (pg. 1965, c.1, pp.1). The Vanadium concentration was  $3.0 \times 10^{17} \text{ cm}^{-3}$ , which encompasses those ranges taught in instant claims 5-7 (pg. 1965, c.1, pp.1). This value of vanadium is less than that of the uncompensated nitrogen concentrations. Uncompensated Nitrogen is N-type. The Sic Crystals are 4H and 6H.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-10, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter et al. (US 2001/0023945) as applied above.

Regarding claims 1-10, Carter and the claims differ in that Carter does not teach the exact same proportions as recited in the instant claims.

However, one of ordinary skill in the art at the time the invention was made would have considered the invention to have been obvious because the compositional proportions taught by Carter overlap the instantly claimed proportions and therefore are considered to establish a prima facie case of obviousness. It would have been obvious to one of ordinary skill in the art to select any portion of the disclosed ranges including the instantly claimed ranges from the ranges disclosed in the prior art reference, particularly in view of the fact that;

“The normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages”, In re Peterson 65 USPQ2d 1379 (CAFC 2003).

Also, In re Geisler 43 USPQ2d 1365 (Fed. Cir. 1997); In re Woodruff, 16 USPQ2d 1934 (CCPA 1976); In re Malagari, 182 USPQ 549, 553 (CCPA 1974) and MPEP 2144.05.

Furthermore, although Carter develops a relationship between Vanadium and Nitrogen doping in SiC. Carter fails to teach the specific relationship instantly claimed in instant claims 8-10. However, it would have been obvious to one having ordinary skill in the art at the time of the invention to adjust the amounts of Nitrogen versus the amounts of Vanadium in SiC for the intended application, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

The applicant is merely discovering and optimizing workable ranges. These instantly taught ranges are for the most part taught in Carter and would have been obvious modifications over Carter, to one of routine skill in the art.



Regarding claims 17, and 18, Carter teaches that a large diameter Sc is desirable ([0006]) however is silent to a diameter of the single crystal. Choosing a diameter to include those instantly claimed is well within the skill and obvious to a routineer in the art of microelectronic device building.

Claims 11, 12, 15, and 16, are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter (US 2001/0023945) as applied above, in view of Jenny et al. (US 2003/0233975)

Regarding claims 11, 12, 15, and 16, Carter Jr teach that the Sic may be 3C, 4H, or 6H crystal ([0035]). The act of polishing is a process limitations given little to no patentable weight. Even if it were given patentable weight it is known in the art that SiC is not immediately used after slicing, but instead is cleaned and polished to prepare a more favorable surface for epitaxial growth ([0045]).

Claims 19 and 20, are rejected under 35 U.S.C. 103(a) as being unpatentable over Carter (US 2001/0023945) as applied above, in view of Faillon et al. (US 6,522,080).

Carter teach using Sic in microwave device field effect transistors, however do not specifically teach the epitaxial growth of GaN or SiC on top of the semi insulating SiC substrates ([0003]-[0007])). However these growth techniques and layers are known in the art of field effect transistors as evidenced by Faillon et al. (see abstract and col. 7, lines 17-25). It would have been obvious to a person having ordinary skill in

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the art at the time the present invention was made to epitaxial grow SiC or GaN on to the semi insulating SiC substrates of Carter et al. in order to build a known field effect transistor device in the art.

### ***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JONATHAN C. LANGMAN whose telephone number is (571)272-4811. The examiner can normally be reached on Mon-Thurs 8:00 am - 6:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on 571-272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JCL

/Timothy M. Speer/  
Primary Examiner  
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